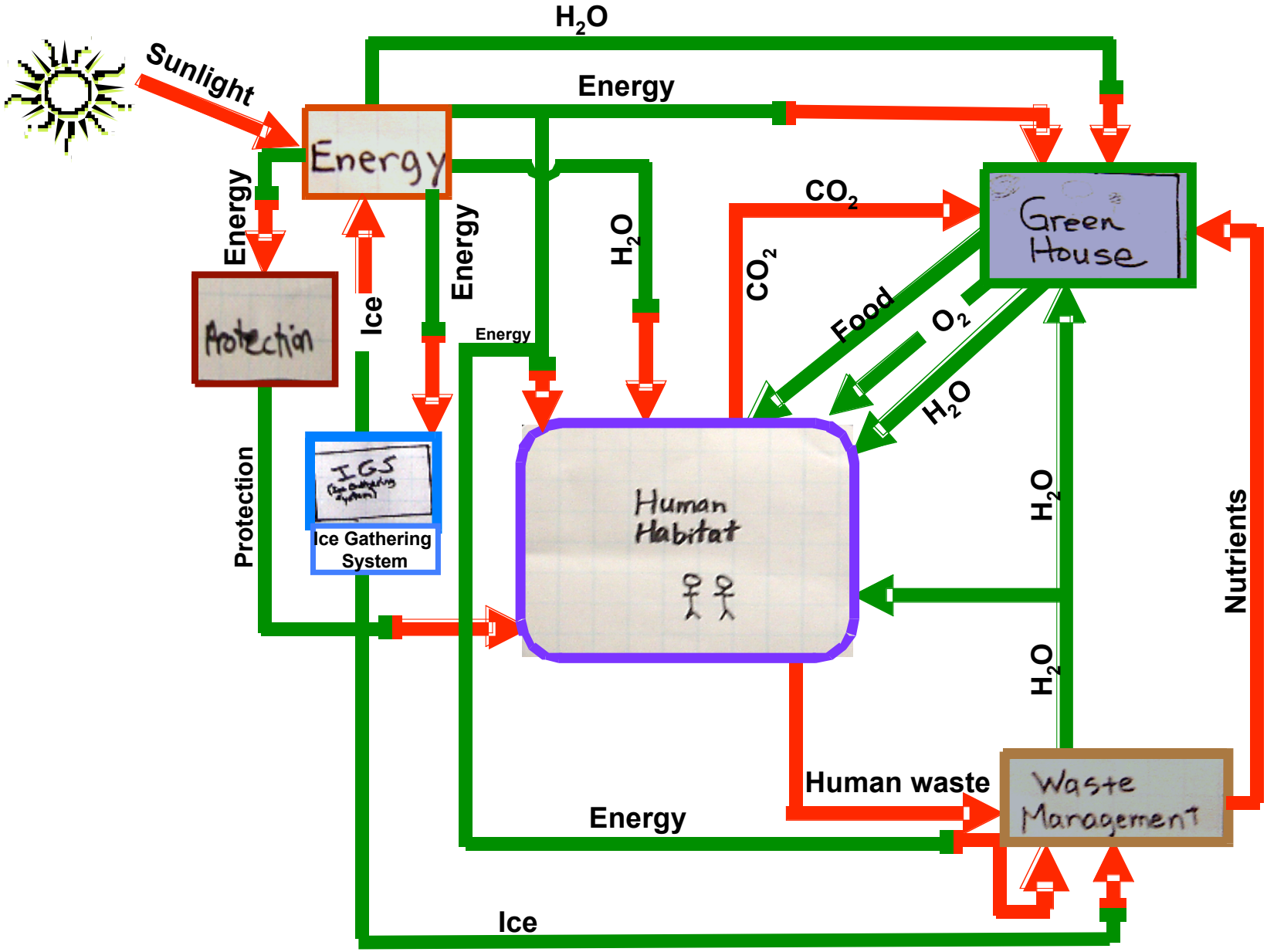
Lunar Research Station Design

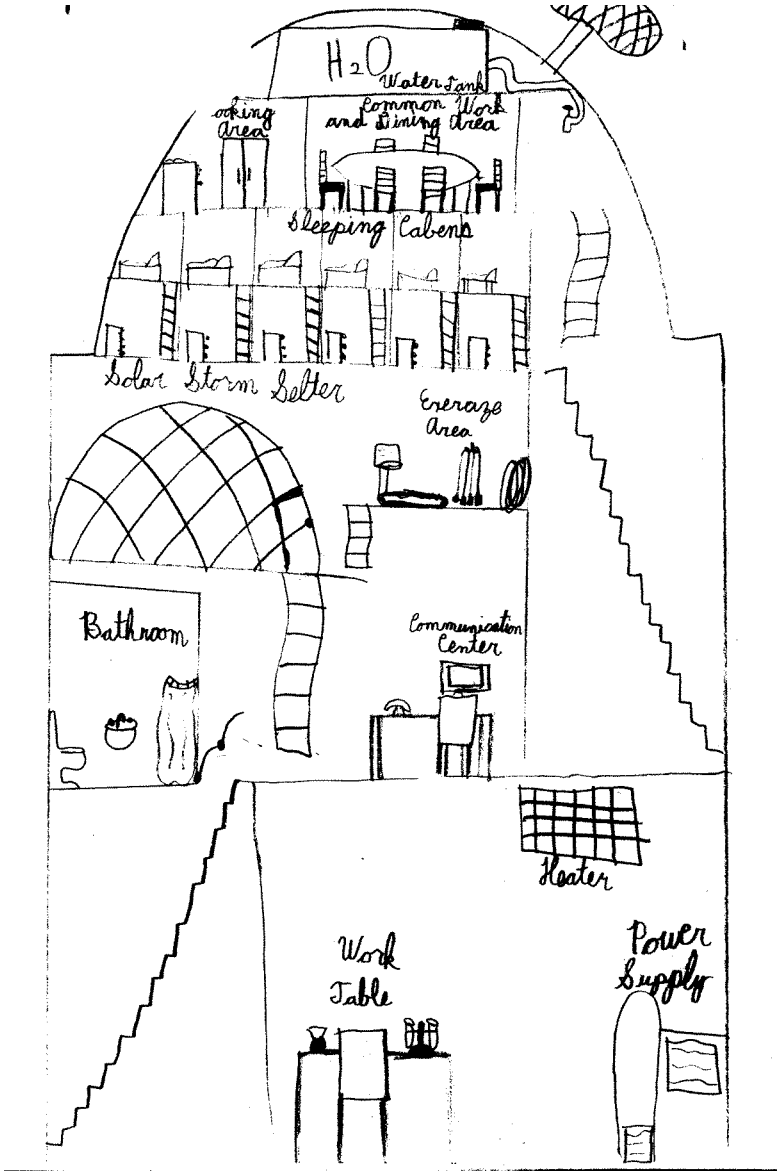
Submitted by
West Valley Elementary GATE Team
October 31, 2006

Contents

Design Overview



Human Habitat / Work Areas cross-section



Upper Level:

Sleeping, Cooking, Dining

Middle Level:

Storm Shelter, Exercise Area, Communications Center, Bathroom

Lower Level:

Work & Research, Heater, Power Supply

Energy System

Description

The Energy System will be a covered dam and solar panels. The solar panels cover the sunniest side or part of the dam where there is no water. (If there is water where the panels are, then the electrical parts of the solar panel will fizz and break.). The solar panels are like a sunflower, following the sun. Sensors **(1)** make the sunflower solar panels turn to face the sun. There are solar cells **(2)** on the sunflower and there is a motor **(3)** that makes the sunflower turn.

The water flows through the opening of the dam, turning a small fan-like mechanism to produce electricity. (Basically what a dam on Earth does.) The solar panels and the "fan" are connected directly **(4)** to the power output to be used for powering car, the lighting grid, etc.

The dam works like this: A big cone-shaped "top" **(5)** (the dam) is where you put the ice that is gathered by the Ice Gathering System (not designed in this project). The sides of the dam **(6)** melt the ice and also generate water. The water is cooled by a cold metal plate **(7)** that falls back after 3 minutes of cooling and gets re-frozen by a generator in the night on the left side of the dam. The now-cooled water falls down and spins a fan **(8)**. A box stores a long copper wire which is stretched out into a line. A magnet attached to the fan rubs against the wire, thereby creating electricity. The made electricity is then sent through cables **(9)** to metal boxes, batteries. In the meantime, the water is sent down a pipe **(10)** to a water station and sent to other areas.
The numbers reference the Energy System layout.

Energy System (continued)

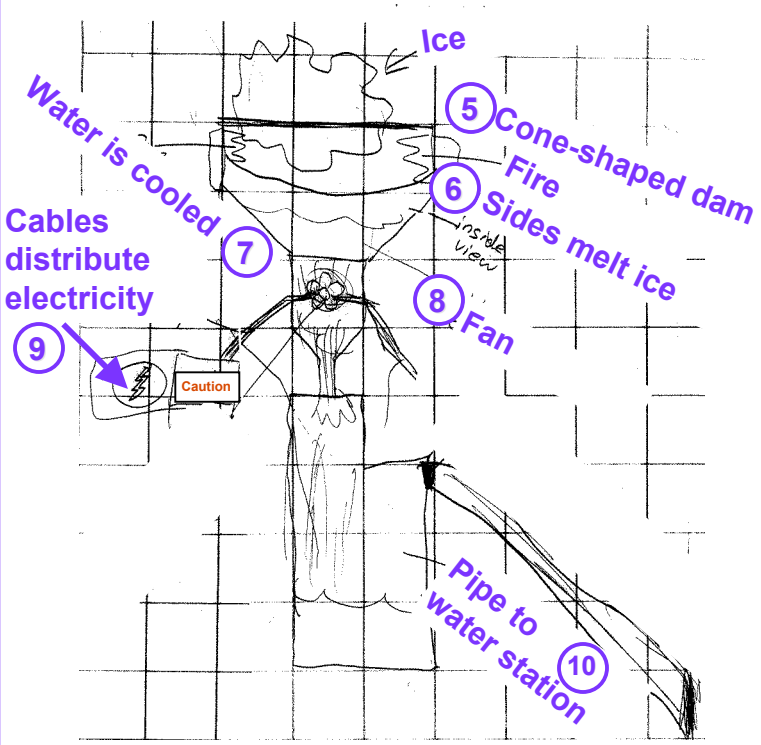
Justification

The solar panels should be on the sunniest side so they can absorb the most sunlight and produce the most electricity, but if they are too near to water than they will short out. We must cool the water down because if hot water touches the metal box with the wire and magnet, it might ruin the contraption. We chose to create electricity this way, because we also get water.

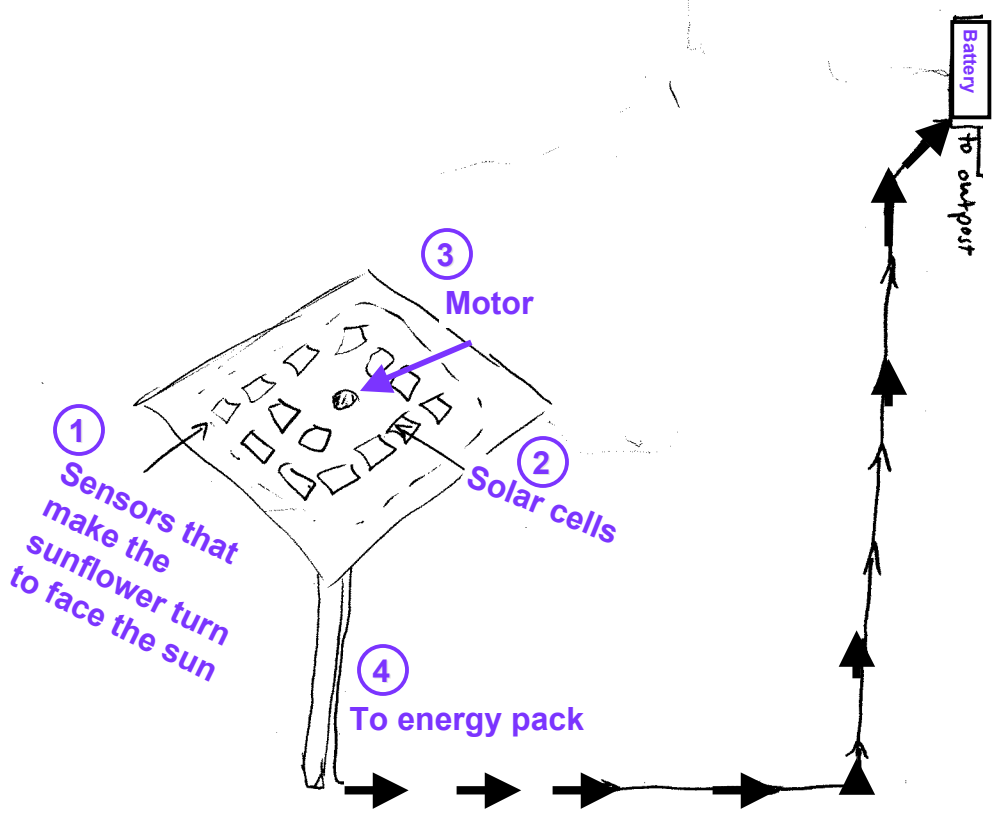
Analysis

One weakness is that the dam might break. Another is that the water might get near the panels. On the other hand, the strength of this design is that is produces lots of energy. Another strength is that it uses sunlight and water as opposed to gases or something found only on Earth.

Energy System (continued)



Dam



Solar Panels

Oxygen Production System

Description

We could put a big greenhouse on the moon to provide oxygen for us. In the greenhouse, we would need fans to keep the air moving so the plants wouldn't suffocate from breathing too much oxygen. There would be a circulation system to bring the oxygen the plants would provide to us, and the carbon dioxide we provide to them so we wouldn't have to be in the greenhouse all the time to exhale CO2 and inhale oxygen. There could be pipes leading from the greenhouse to the outposts and fans to keep it moving back and forth. The plants are also a food source.

Another idea is a type of a cycle. First, we have a guy. He releases urine and feces. They go to a microbial bioreactor. The microbial bioreactor turns it into CO2 and nutrients, which are sent to the greenhouse. The greenhouse releases food, water, and oxygen to the guy. Now the guy can eat, sleep, and breathe. The guy also produces grey water (like dirty sink water) to both the bioreactor and the greenhouse.

The leftover stuff from the plants, like inedible material and O2, goes to the bioreactor. Once most of the CO2 is converted we'll use a valve to fill oxygen tanks for humans. On the humans we'll connect the tanks to their spacesuit.

We'll also send a few spaceships with extra oxygen once a month.

Oxygen Production System (continued)

Justification

This idea is good because after we get a microbial bioreactor and a greenhouse it is pretty self sustaining. It also gives us food, water, and oxygen quite quickly. It also moves it so we do not have to deal with our waste. It also just keeps going.

We are using this system because nuclear fission to water is complicated and expensive. Using plants is a way to get oxygen quickly. Humans will probably not struggle too much. Using a microbial bioreactor might be too strenuous. If we have technical problems we won't have oxygen for a long time. Nature has a less chance of denying our needs.

I think we should have the circulation system with the pipes instead of having to go into the greenhouse to breathe O2 and give CO2 or having to bring in large supplies of O2.

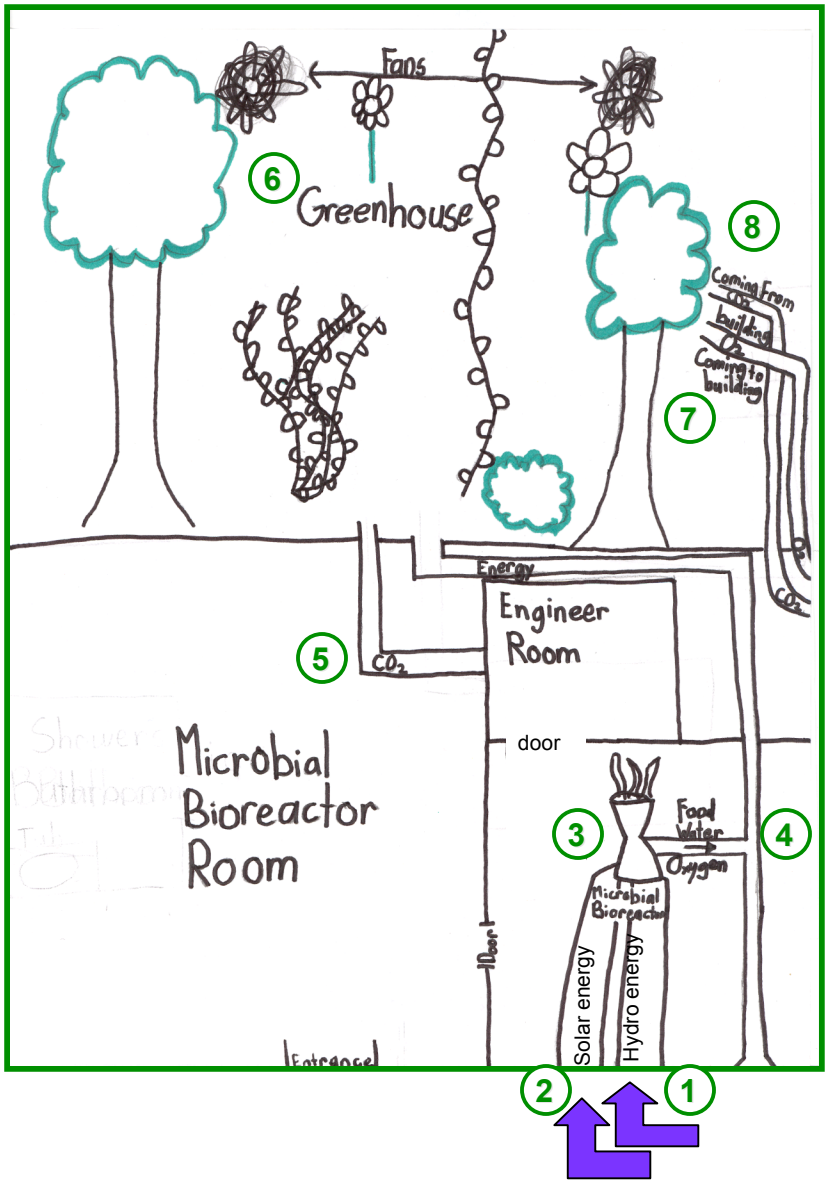
Oxygen Production System (continued)

Analysis

One of the weaknesses in this design is that the plants would need water, so that would take away a lot of H2O from the supply. Another weakness is that the plants need carbon dioxide, so we would need to give them more than we like. We might have to be on the moon all the time. We would also have to get an expensive bioreactor. There are a lot of things that could go wrong, and we will need topnotch equipment and employees. It is difficult to sustain a greenhouse in space. For this plan, we will need quite a few of them. Also, the humans have to wear spacesuits, which aren't casual and are hard to move around with. Circulation of CO2 and O2 might create CO4. We'll have to hire people to pilot the spaceship with extra oxygen tanks. We'll have to pay high wages so people will do it.

On the other hand, this design has the following strengths: It produces food, water, and oxygen, not just oxygen. The greenhouse would provide oxygen, which we really need; and the plants would give us food to eat. Also, this style is self-sustaining and it helps us deal with waste. And while we might have technical difficulties with microbial bioreactors and nuclear fission, we will not have problems with plants and nature. A lot of people will get oxygen quickly using this method. Also, no oxygen can escape unless you're filling an air tank and forget to turn off the valve.

Oxygen Production System (continued)



1. Hydro energy comes from the energy system.

2. Solar energy also comes from energy system.

3. Microbial Bioreactor: for growing bacteria that are used in the bioconversion of waste.

4. Food, Water, and O2 are released from the bioreactor. It will supply the inhabitants.

5. CO2 released from engineer room: CO2 will be supplied from our workers which we will feed to the plants in order to receive our O2.

6. The greenhouse will have plants in it which will supply O2 after we give it some CO2. Fans will help circulate the O2 and CO2.

7. The O2 supply pipe. There will be suction and a CO2 releasing system will suck in O2 and keep out CO2 supplying people with pure O2.

8. The CO2 disposal pipe will take CO2 from civilians' houses and return it to the greenhouse to get O2. Again, there will be a suction system.

Waste Management System

Description

The waste management process works by using pipes to connect to two big vaults. One of the pipes collects soapy water, human waste, and any other waste materials. They are dumped into the purifying vault. The vault contains many layers of filters. The filters lift up and all the human waste gets scooped into a smaller vault. It is then made into fertilizer or fuel for cooking. The other pipe is divided into two mini pipes. They lead into a big vault, which also has two sections – hot water and cold water. All the pipes connect to every toilet, sink, and shower stall. The purifying vault connects to the other vault so purified water can be reused. For the vault that has water, the cold water is made by sending ice into it. Rovers go to the polar caps and dig up ice. The hot water is produced by blinding lights heating it up.

Waste Management System (continued)

Description, continued

The following numbers reference the Waste Management layout:

(1) The bathroom is a great place to be. There are four sinks with pipes connecting to it. Three toilet and three shower stalls are all on one wall. On another wall, are six cabinets to store toothbrushes, cups, toothpaste, and others. Next to the door there are six mirrors against the wall.

(2) This is the water vault. It is separated into two sections – hot water and cold water. One side generated cold water, and the other side generates hot water. There are three pipes connected to this vault. One links the vault to the four sinks, the other leads to the three showerheads and the three toilets. The last one connects to the purifying vault, so that the water that was just cleaned can be supplied again.

(3) The vault you see here is the purifying vault. It has many layers of filters that will purify the dirty water and human waste. It has pipes that connect to the same things as the water vault. The feces that can't be filtered goes into another vault. Once the human waste has been purified it goes into a different vault that will change its temperature.

(4) This is the solid waste vault. It holds the feces that are dumped into it from the purifying vault. It is later changed into fertilizer to give to the greenhouse.

Waste Management System (continued)

Description, continued

The following numbers reference the Waste Management layout:

(5) This machine sucks ice that the rover provides. After the rovers have deposited ice into the icebox, it is crushed into littler pieces and is sucked into the temperature vault. It will then be used to cool water.
(6) The rovers are used to get ice from the polar caps. Once they have collected the ice they bring them back and dump them in the icebox.
(7) If you want cold or hot water then you turn on the sink. To get this hot or cold water it goes through a pipe. This pipe is connected to the water vault.
(8) After you use the water in the sink, it goes into a pipe that connects to the purifying vault.
(9) The waste from the showers and toilets goes into the purifying vault.
(10) From the water vault, either hot or cold water goes to the showers and toilets.

Waste Management System (continued)

Justification

We turn the waste into water because on the moon you need water and this way you don't waste any. Instead of letting all the waste go out in space we thought of re-using it; then there will not be space pollution. We use rovers to get ice because we think this is a fast way and we're using the resources. Also, humans might get cold and they wouldn't get a lot. We use fertilizer made from human waste because then we don't have to ship it down to earth every couple of months and we will not have to bring up fertilizer for plants.

We decide to use:

Rovers – because it is an easy way to get to the polar caps without humans getting any possible injuries.

Human waste fertilizer and fuel – because we plan to grow crops which need fertilizer. We also don't want the solid waste to go to waste or cause pollution.

Pipes – Aluminum and plastic is used because they are non-magnetic

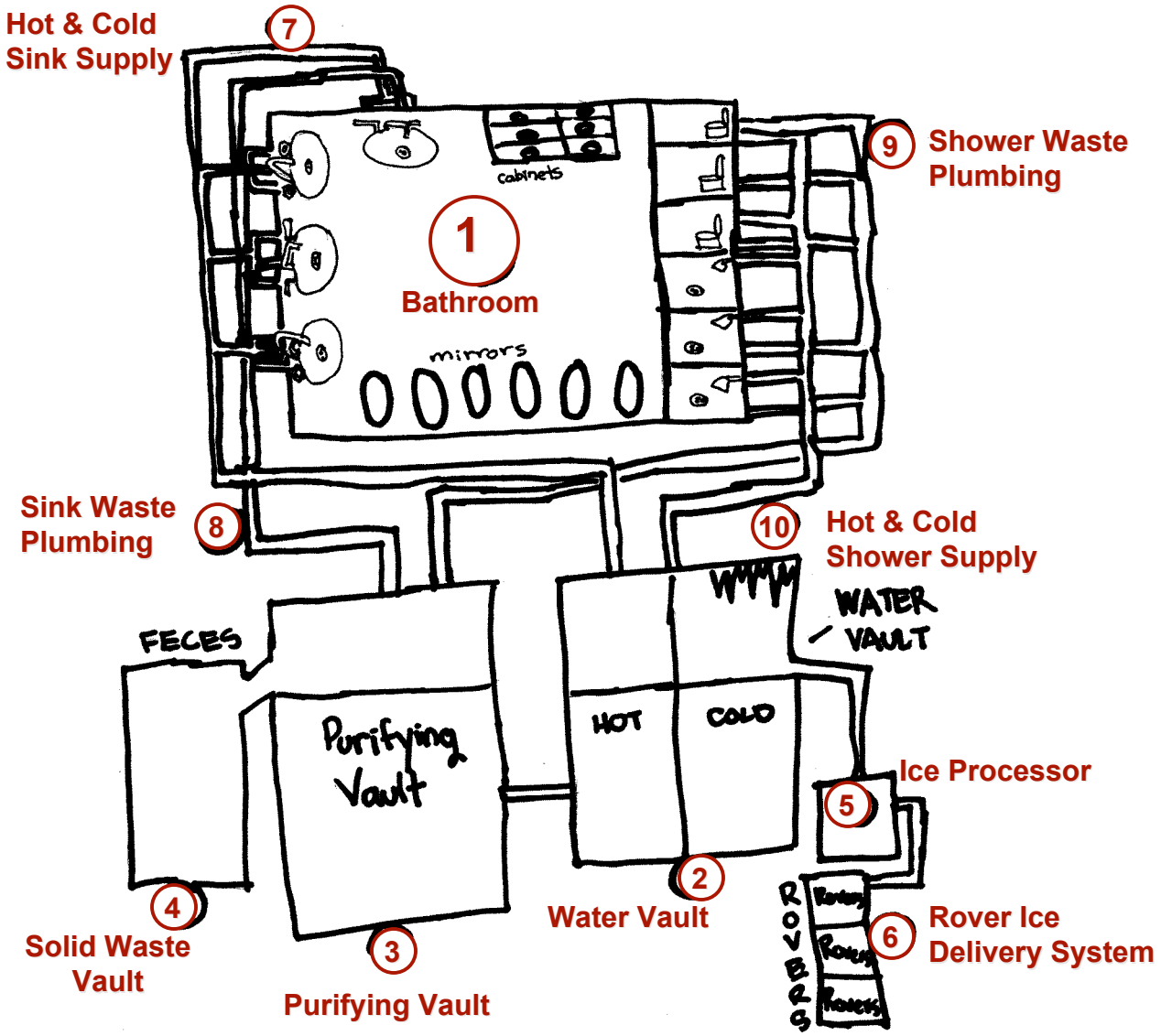
Waste Management System (continued)

Analysis

One of the weaknesses of the design is the fertilizer. If the fertilizer doesn't work, we could get sick eating the plants. Another potential problem is the pipes. If the pipes break, we don't have water to live with. The material we use for pipes are not very good. We are also worried about the rovers. We don't know if they will work or how they'll work.

On the other hand, the strength of this design is that we are reusing what we already had.

Waste Management System



Protection System: lightning wall

Description

The letters reference the Protection System layout:

A lightning wall above our lunar outpost **(A)** would need its own set of solar panels **(B)** to run. To start it up, the panels would need to be working a few days before the start of the lightning to get the energy needed. A wire will connect the lightning-maker **(C/D)** to the solar panels. Once the lightning **(E)** zaps across to the metal bar on the other side, very little energy is lost. Then there is energy to send it back. Shades and cement walls would protect eyes from the constant light.

Justification

If there is a lightning wall above our outpost, meteors couldn't destroy our buildings. Cement (it is not a conductor) walls below and to the sides of the lightning wall will prevent becoming blind unless you are in a spaceship looking from above. There isn't enough time to deflect meteors off a moon course.

Analysis

One weakness is that it will consume a lot of energy. Another weakness is that it prevents solar panels on the roof. Also, it just might mess up and start a fire.

However, it provides protection from meteors. Solar panels could be placed around the perimeter and make energy with the light. Its light could guide in a lost spaceship.

Protection System: radiation shields

Description

The letters reference the Protection System layout:

To protect against radiation, we could design a robot to pick up moon dust for radiation shields. Once the oxygen is extracted from the moon dust, the leftover can be used to make slag. Slag is very useful, as it can be made into concrete, bricks, radiation shields, and more. We can put radiation shields **(G/H)** between two "radiation shield proof" coatings in the space suits. Radiation shields can also be placed inside and outside the walls **(F).**

Justification

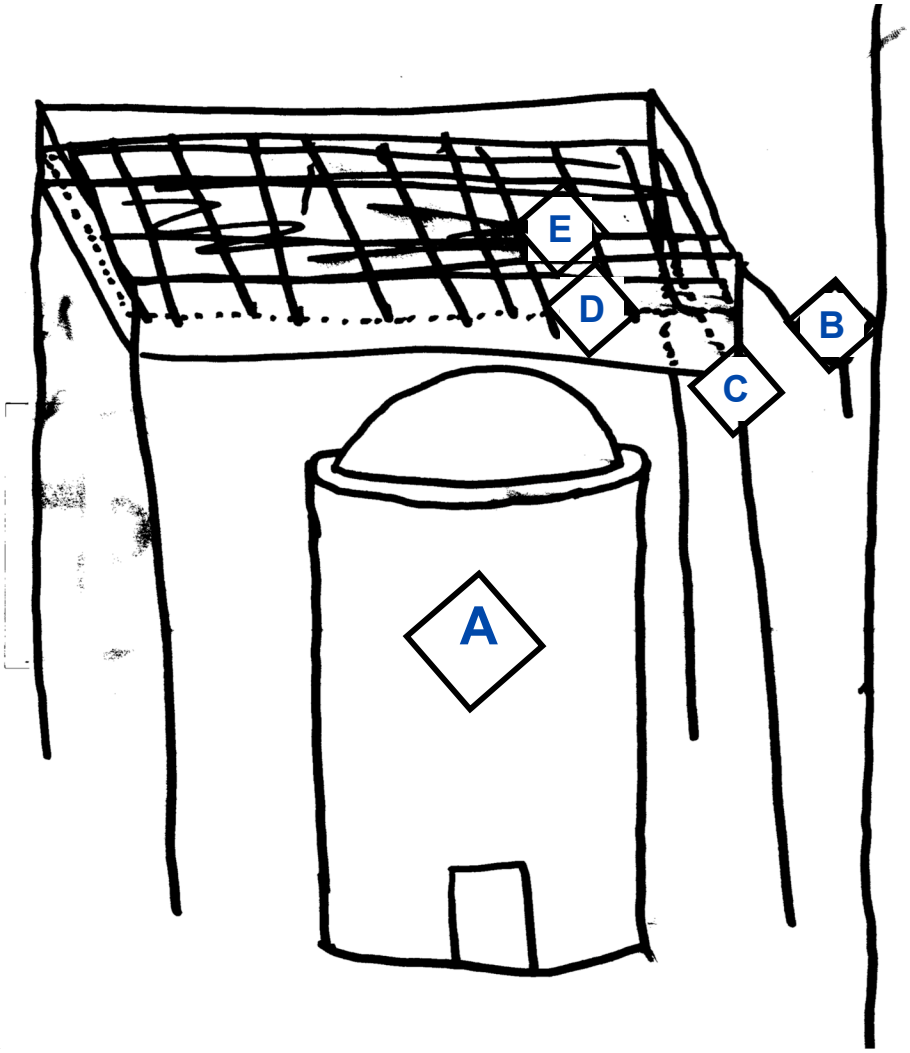
Slag shields would be built on the moon to save space on the storage ships. If slag is attracted to a magnet and moves into the lungs, they could die. Slag proof coatings would prevent this.

Analysis

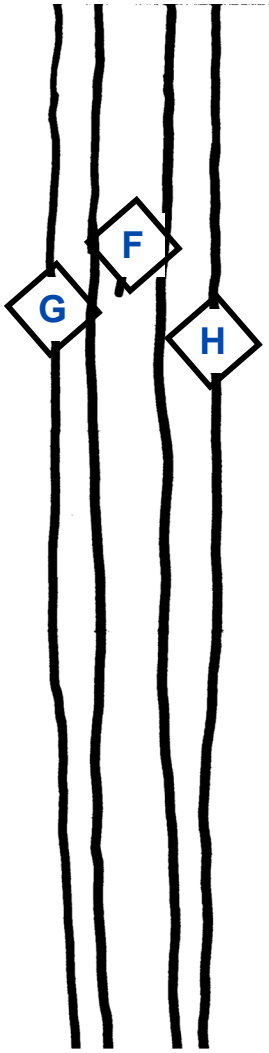
One of the weaknesses is that a hole in the coatings could kill the wearer. Also, robots would consume energy and we would need to send up robot to get slag before the people.

On the other hand, the system provides good radiation protection and saves space on the equipment ship. Another strength is that the coating protects from ordinary moon dust.

Protection System (continued)



Lightning Wall



Radiation Shield